

A new *Leucospis* Fabricius (Hymenoptera: Leucospidae), the First Reported Gregarious Species

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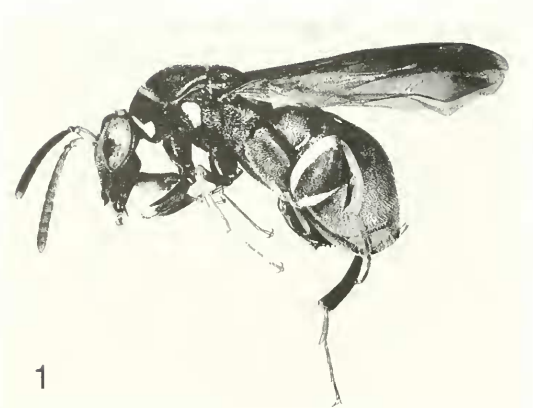
Abstract.—*Leucospis pinna* Grissell and Cameron, new species, is described from Ecuador. It is a parasitoid of the orchid bee *Eulaema meriana* (Olivier) (Hymenoptera: Apidae) and is the first species of *Leucospis* reported to parasitize bees in the tribe Euglossini. It is the first known member of the family reported to have gregarious larvae.

The genus *Leucospis* Fabricius was revised at the world level in 1974 when 109 species were recognized (Bouček 1974a). Since then five new species have been described and one name has been synonymized (Bouček 1974b, Habu 1977, Bouček and Narendran 1981, Naumann 1981, Engel 2002). Of the described species, 44 are from the New World with the great majority being Neotropical (Bouček 1974a, b). Although the entire family of Leucospidae (about 130 species) is thought to be parasitic upon aculeate Hymenoptera—solitary bees and less frequently solitary wasps—hosts are actually known only for about 30 species, and for most of these the biology remains essentially undocumented (Bouček 1974a, Noyes 2001).

Bouček (1974a) reviewed biological reports on leucospids, but most literature amounted to observations about oviposition and egg and larval morphology. Only three species are relatively well known biologically: *L. gigas* F. (Palearctic), *L. affinis* Say (Nearctic), and *L. japonica* Walker (Palearctic). Information for *L. gigas* is largely based on original work done by Fábry (1855) and subsequently summarized by workers such as Clausen (1940), Malyshev (1968), Bouček (1974a), and Hanson

(1995). In this species, several eggs were laid on each host and the active first instar larva “searches out and destroys any competitors that may be present in the same cell” (Hanson 1995). Graenicher (1906) reported on *L. affinis*, stating that it was a solitary external parasitoid with an active first instar larva that sought out the bee host within its cell (or cocoon). He could not confirm active cannibalism but stated that both rival egg and larval destruction was likely, based on his observations of the incessant movement of the single larva he found in each of three cells. *Leucospis japonica* (data summarized by Habu 1962) follows the same pattern, with the first instar larva moving about by bristles on the abdominal segments and killing off any other leucospid larva present on the host. Other than observations on these three species, relatively little is known about the life history of Leucospidae.

In this paper we describe a new *Leucospis* species attacking the large orchid bee *Eulaema meriana* (Olivier) (Hymenoptera: Apidae), the biology of which will be discussed in another paper (Cameron and Ramírez 2001). Our report is the first account of a *Leucospis* parasitizing bees in the tribe Euglossini (Apidae), although



Figs. 1-2. *Leucospis pinna*, habitus. 1, Female. 2, Male.

three species of the related genus *Polistimorpha* Westwood are known to attack bees in the genus *Euglossa* Lepeletier (Bouček 1974a). More significantly, this new species represents the first report of a gregarious ectoparasitoid species (i.e., multiple individuals emerging from the same brood cell) in the genus *Leucospis*.

Leucospis pinna Grissell and Cameron,
new species
(Figs. 1-9, 12-17)

Holotype female (Fig. 1).—Length 8.3 mm. Black to reddish brown with weak metallic tinge except yellow as follows: venter of flagellum, scape entirely, pronotum with narrow transverse band along apical and posterior margins, apical band extending to anterolateral corner and forming ovoid spot, midlobe of scutum with narrow band on lateral and posterior margins, posterior half of acropleuron, apex of metacoxa, apex of pro- and mesofemora, dorsal and ventral band on metafemur (Fig. 8, indicated by dotted lines), dorsum of all tibiae, pro- and mesotarsi, metatarsus ventrally (shading to brown dorsally), ovipositor sheath. Brown to reddish brown are: dorsum of flagellum, tegula, wing veins, upper third of wing, and trochanters. *Head*: Distinctly narrower than pronotum, dorsally about 3.5× wider than long, in facial view about as high as

wide (Fig. 3); occipital carina sharp, elevated, visible from front of head (Fig. 3); postocellar length (POL) 2.0× ocellocular length (OOL); ocellar area about 2.8× as broad as long; scrobal depression transversely lightly striate, carinate dorsally and basolaterally but not mediolaterally (Fig. 3); eye distinctly emarginate along inner margin. Frontovortex punctate, changing to reticulate rugose at eye emargination to lower margin of face; interantennal area with slight median keel extending partially to clypeus. Clypeus (Fig. 4) slightly broader than high, apical margin produced, slightly bilobed, without median tooth, margin carinate, slightly depressed along carina, laterally carinate at some angles of view (not apparent at some angles), apicomedian area punctate with carinae radiating dorsally to slightly above midpoint, area above with well-defined setose punctures about own diameter apart. Antenna as in Fig. 6, scape about 3× as long as broad, ventrally flat, polished (Fig. 7), otherwise covered with nearly contiguous setose punctures. Mandible (Fig. 4) with deeply semicircular broad gap separating sharp lower tooth. Eye and face (except scrobal depression) covered with short, silvery setae. *Mesosoma*: Except as noted, covered with nearly contiguous setose punctures separated by interstices less than 0.2 to 0.5 puncture

diameter, interspaces finely aciculate; dorsellum and propodeum more densely punctate and pubescent than scutum; lateral pronotum rugulose; femoral depression deep, polished to aciculate. Pronotum without transverse carinae. Mesoscutum without vestiges of parapsidal line or notaulus. Tegula punctate with edges barely aciculate. Scutellum about $1.8\times$ wider than long. Dorsellum distinctly transverse, rectangular, $4\times$ wider than long; lateral panel of metanotum obscured by long, silvery pubescence. Propodeum medially $3\times$ as long as dorsellum, median carina raised into fin-like lamella, dorsally curved and posteriorly concave (Fig. 5); plica extremely well-developed, raised distinctly above surface of propodeum; spiracle, postspiracular sulcus, and callus obscured by long, dense golden pubescence; posterolateral corner angled with deep carinate concavity between it and metapleuron. Pro- and mesocoxae transversely carinate on outer surface; metacoxa (Fig. 8) in lateral (flat) view with depression evenly punctate, punctures several times own diameter apart and interstices appear polished (Fig. 8a), in oblique view punctures appear longitudinally elongate, separated by minute parallel striae (Fig. 8b), and surface appears covered with minute carinae or striae; ventral surface with minute punctures separated by polished interstices less than puncture diameter apart; punctures on entire coxa each with minute setae (less than puncture diameter in length). Metafemur (Fig. 8) about $2\times$ as long as broad, basal tooth in middle followed by 6 or 7 smaller, irregular-sized teeth; punctation nearly touching, dense and evenly spaced over entire surface (Fig. 8c), each with minute seta. Apex of metatibia (Fig. 9) with outer spur distinctly articulated basally, curved, pointed, and about $0.8\times$ width of tibial apex; inner spur apically blunt but with tuft of setae making spur appear pointed, in side (Fig. 9, inset) view spur flattened, curving distally, and about $0.8\times$ width of tibial apex.

Metabasitarsus (Fig. 8) dorsally about $1.5\times$ apical breadth of tibia. Forewing with ratio of submarginal:marginal:stigmatal:postmarginal about 11:3:2:8, patterned brown as in Fig. 12. *Metasoma*: In dorsal view, apical terga (2–5) parallel sided (Fig. 13), metasomal terga 6 (apparent 4) bulging; in side view (Fig. 14) metasomal tergum 6 greatly convex dorsally, slightly angled near apex above ovipositor sheaths; metastomal tergum 1 (petiole) not apparent; metasomal tergum 2 (first apparent) with anterolateral corners angled sharply, anterior margin polished, posterior margin with narrow polished band, otherwise densely punctate, each puncture with recumbent, backward projecting seta about $2\times$ length of puncture diameter; apical punctures medially somewhat crenulate to longitudinally elongate, nearly touching, becoming round laterally and posteriorly, separated at least by own diameter, interspaces polished; metasomal tergum 3 not visible from above; metasomal tergum 4 visible as narrow band with slight transverse striae, without punctures; metasomal tergum 5 with complete median split, covered with contiguous dense punctation obscured by elongate golden or silvery setae each 5 or more times puncture diameter; metasomal tergum 6 with slight median split from apex about one-third distance to posterior margin, entirely covered with nearly contiguous dense punctures less than own diameter apart, interspaces slightly striate, each puncture with appressed silvery seta, setae increasing in length from dorsal surface (about 2 or 3 puncture diameters in length) posteriorly (near ovipositor sheaths) to about same length as on metasomal tergum 5; metasomal tergum 7 and 8 (syntergum) similar to dorsum of 6, 7 dorsally split; ovipositor sheath straight, exerted scarcely greater than length of inner metatibial spur; hypopygium apically pointed, reaching nearly to posterior of metasomal tergum 6.

Male paratypes (Fig. 2).—All about 7 mm

in length. Similar to female except as follows: Scape reddish brown, ventrally with irregular punctures similar to, but less dense than, those on sides and dorsum. In dorsal view metasoma bulging laterally (Fig. 16), in side view dorsal margin convex (Fig. 15); metasomal tergum 3 not apparent from above (possibly seen as small laterotergite at side, Fig. 15), terga 4–7 fused dorsally, with 4 (apparent 2) separated from 5 by row of distinct pits, terga 8 and 9 distinct; metasomal terga 2 and 4 with distinct laterotergites (Fig. 15), tergum 5 with indistinct laterotergite (fused along top margin but slightly indicated at anterodorsal corner, Fig. 15), punctuation on metasomal tergum 2 about as on scutellum, remainder of terga sculptured about as for female; setae similar overall but slightly longer on posterior of terga 4–7; metasomal sterna rigid, wide (Fig. 17), punctures largest on apparent sternum 1 decreasing in size to sternum 6, which is medially impunctate, sternum 7 impunctate; sternum 1 with median hook-like projection (best seen in profile, Fig. 15), apex of sterna 1 and 2 medially angled, surface of sterna 6 and 7 slightly to moderately medially concave.

Variation.—Females range in length from about 7 to 9 mm. The type series is consistent in most features. In some females, metasomal tergum 4 is scarcely visible as a narrow strip, whereas on others it is wide enough to see weak punctures and setae. The few males we have seen do not appear to vary even in length.

Type material.—Holotype female: Ecuador, Orellana, Tiputini Biodiversity Sta., 3–13-VII-2000, S. Cameron, emerged from cells in nest of *Eulaema meriana* "lizard nest" (National Museum Natural History, Washington, DC [USNM]); 39 female, 11 male paratypes same data as holotype (in Illinois Natural History Survey, University of Illinois and USNM).

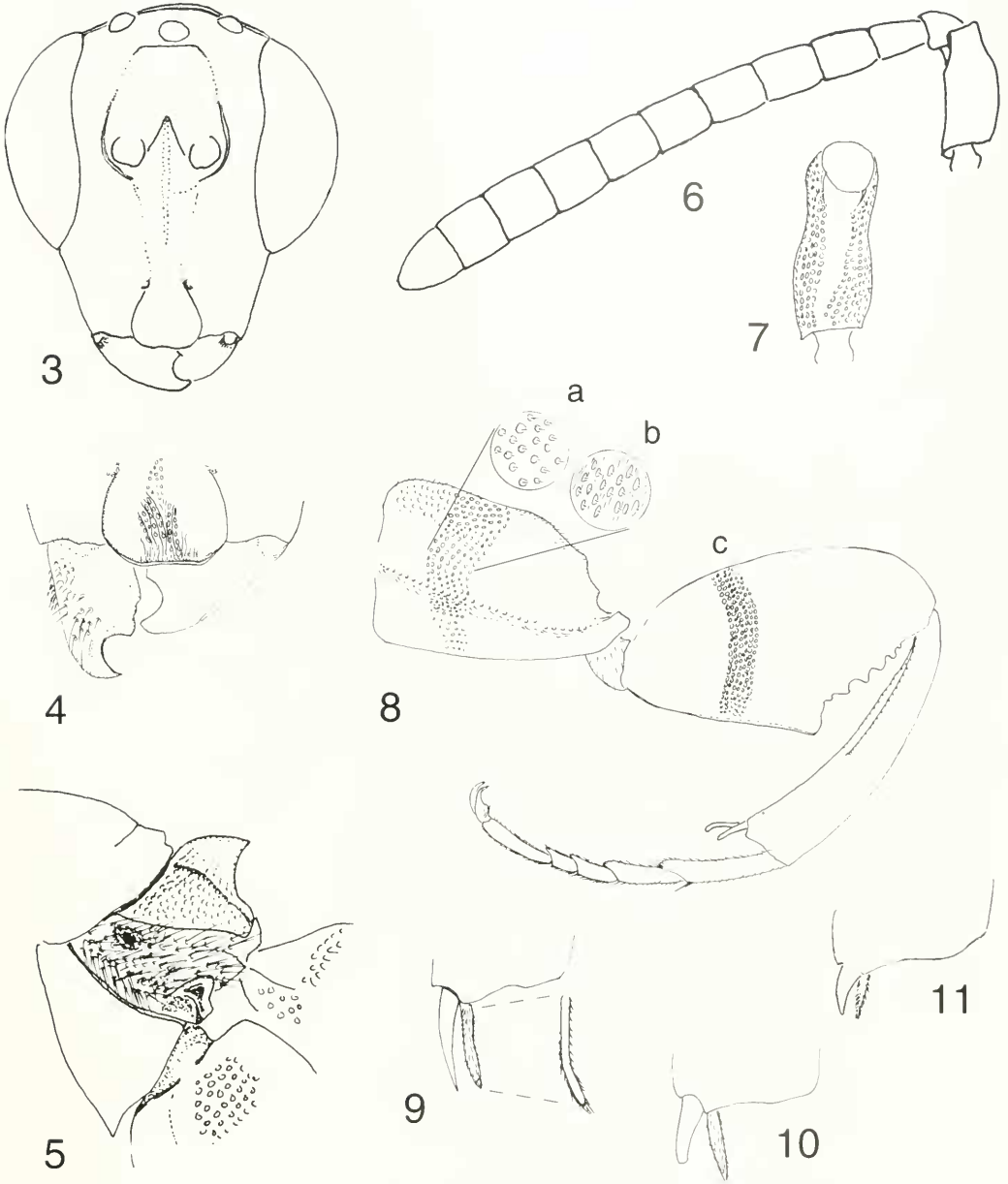
Host.—Cells of *Eulaema meriana* (nest deposited at the Illinois Natural History Survey, University of Illinois).

Distribution.—Known only from the type locality in Ecuador. It is the fifth species reported from this country (Bouček 1974a, b, Noyes 2001).

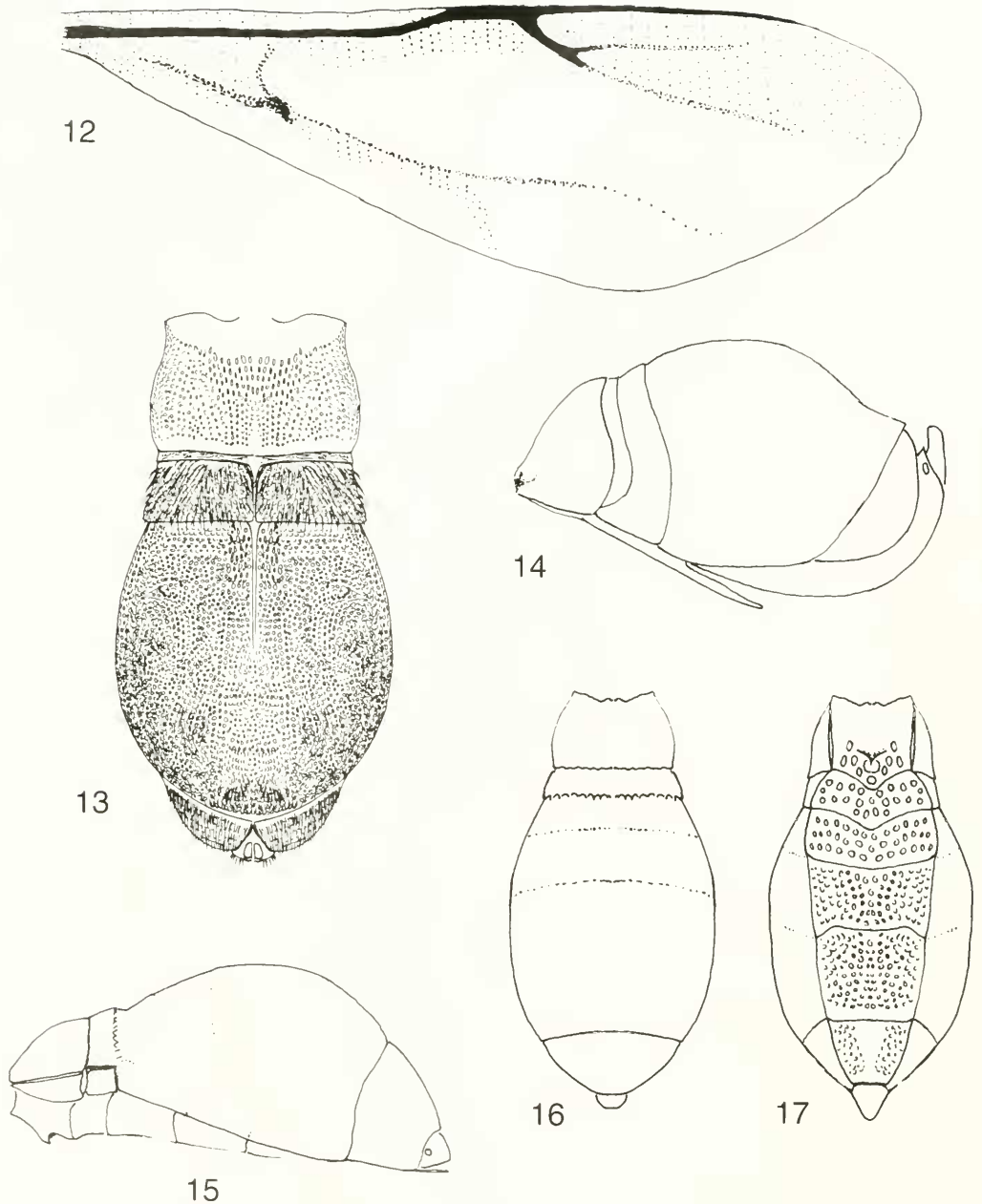
Etymology.—The species name is derived from the latin *pinna* meaning "fin," in reference to the distinctive finlike propodeal projection.

Discussion.—This species would be placed in the *cayennensis* species-group as defined by Bouček (1974a), with the exception of one character, the ovipositor sheath length. Within New World *Leucospis*, the *cayennensis* species-group is unique in having the lower tooth of the mandible separated from the upper edge by a broad semicircular gap (Fig. 4). This group, composed of 8 species, is also defined by the following: the body has a slight metallic tinge, the pronotum is without a premarginal cross-carina, the propodeum is densely pilose, the sterna in males are broad and sculptured, and all species have a Central to South American distribution. In all respects, *Leucospis pinna* fits these criteria. It disagrees from other members of the group only in having extremely short ovipositor sheaths (Fig. 14), which Bouček (1974a) used, in part, to define the *texana* species group. This latter group has a stout metafemur with 4–5 long ventral teeth and a small basal tooth. All remaining New World *Leucospis*, including the *cayennensis* species group, have the metafemur with a broad basal tooth followed by 7 or more small teeth (Fig. 8).

Although Bouček's key to world leucospid species (1974a; supplemented by a modified key in 1974b) is a comprehensive monograph, the discovery of a new species that somewhat alters or modifies a species-group concept suggests that additional such cases are probable. It is likely that species groups may even change composition and definition depending on new species certainly awaiting discovery. For this reason, and because of the autapomorphy discussed below, we outline the



Figs. 3–11. *Leucospis* species, females. 3–8. *Leucospis pinna*. 3, Head. 4, Lower face, clypeus, and mandibles. 5, Propodeum, side view (with partial aspects of scutellum, metanotum, metapleuron, metacoxa, and apical metasoma). 6, Antenna, lateral. 7, Scape, ventral. 8, Metaleg, insets show example of sculpture on coxa and metafemur: a = punctures in lateral view; b = punctures viewed at oblique angle; c = punctures in lateral view; dotted lines on femur denote color pattern. 9–11. Metatibia, apex, outer view. 9, *Leucospis pinna*, inset showing inner spur in side view. 10, *L. cayennensis*. 11, *L. ignota*.



Figs. 12-17. *Leucospis pinna*. 12-14. Female. 12, Wing, dorsal view, stipling denotes color pattern. 13, Metasoma, dorsal view. 14, Metasoma, lateral view. 15-17. Male, metasoma. 15, Lateral view. 16, Dorsal view. 17, Ventral view.

major differences and distinctions of *Leucospis pinna* relative to Bouček's key and other species of the genus.

Leucospis pinna does not precisely fit any of the couplets in Bouček (1974) and splits

the first couplet by having the ovipositor sheaths as described for the *texana* species-group (i.e., barely exerted) but the metafemur as described for all the remaining species of *Leucospis*. Ignoring the oviposi-

tor, *Leucospis pinna* then keys directly to the *cayennensis* species-group by virtue of all the characters mentioned above. Within the group, *L. pinna* will key positively only through the first species-group couplet (Bouček 1974a, couplet 6) separating it from *L. cayennensis* Westwood and *L. mexicana* Walker on the basis of the depression of the metacoxa being punctate (polished and smooth in the latter two species). *Leucospis pinna* splits couplet 7 by having a combination of characters. It differs from *L. metatibialis* Bouček in having a heavily setose dorsellum (as in *L. metatibialis*), but it is convex not flat, as in *L. metatibialis*. It differs also in having the metatibia densely punctured (sparsely so in *L. metatibialis*), and the short ovipositor (reaching metasomal tergum 2 in *L. metatibialis*). In couplet 8a (Bouček 1974b) *L. pinna* differs from *L. genalis* Bouček and *L. leptomera* Bouček in the broad metafemur (narrow in *L. genalis* and *L. leptomera*) and in having metasomal tergum 2, in dorsal view, narrower in width than the remainder of the metasoma (subequal in width in *L. genalis* and *L. leptomera*) but agrees in the malar space greater than two-thirds the length of the scape (one-half or less in other species of the *cayennensis* species-group). If *Leucospis pinna* is taken further in the key, it would stop at couplet 9 based on the densely setose and finely punctate propodeum, which it shares with *L. ignota* Walker. It differs from this latter species, however, in the convex dorsellum (flattened and lamellate in *L. ignota*) as well as the barely exerted ovipositor (reaching nearly one-third distance to propodeum in *L. ignota*).

Leucospis pinna is well-defined based upon an autapomorphy of the propodeum, namely an expansion of the median carina into an asymmetric, thin, hook-like lamella (Fig. 5). No other member of the *cayennensis* species-group (and apparently no other described species) has such a pronounced median propodeal carina. In a few New World members of the *speifera*

species-group the propodeum has a median, slightly raised keel, which takes the form of a thickened, gradual arch the length of the propodeum.

Another character that aids in the recognition of this species is the structure of the metatibial spurs. In *L. pinna* they are elongate (nearly 0.8× length of tibial apex), with the outer spur distinctly articulated basally, curved, and sharply pointed apically, and the inner spur somewhat flattened, and curved with a tuft of setae at the apex (Fig. 9). Within the *cayennensis* species-group, species have the spurs relatively short and stout (Figs. 10, 11; less than 0.5× tibial apex). The apex of the outer spur may be bluntly chisel-shaped (Fig. 10) or sharp (Fig. 11), and in some cases they may appear to have no basal articulation (Fig. 11).

Biology.—*Leucospis pinna* is the ninth species known for the *cayennensis* species-group, within which only *L. cayennensis* has had positive biological associations. These associations have all been exclusively with the genus *Centris* (Hymenoptera: Apinae), including *C. tarsata* Smith (Fritz and Genise 1980, Chandler et al. 1985), *C. bicornuta* Mocsáry, *C. nitida* F. Smith, *C. analis* F., and *C. vittata* Lepeletier (Cooperband et al. 1999, Vieira de Jesus and Garofalo 2000). Bouček (1974a) stated that *L. ignota* (Walker) was collected at adobe walls "presumably at the nesting sites of host bees." Other than these sketchy reports, little is known about the biology of other members of the *cayennensis* species-group.

Leucospis pinna was collected from a single nest of *E. meriana*. As described by Cameron and Ramírez (in press), a total of 51 individuals emerged from only 2 cells (28 from one cell, 23 from another). Thus, there is no doubt about the gregarious nature of this species. The sex ratio was highly female-skewed within each cell, with only 6 males emerging from the first cell and 5 from the second, respectively. Further study is required to determine

whether gregarious adult emergence is a derived state or the ancestral condition within Leucospidae.

Mimicry.—*Leucospis pinna* resembles *L. egaia* Walker and *L. latifrons* Schletterer at least superficially in both color and size. Both of these are said to mimic *Polybia occidentalis* (Olivier) (Hanson 1995) as might *L. pinna* (Chris Starr, pers. comm.). As has been pointed out by Bouček (1974a), *Leucospis* species appear to mimic taxa having no apparent relationship to the hosts upon which they oviposit.

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LITERATURE CITED

- Bouček, Z. 1974a. A revision of the Leucospidae (Hymenoptera: Chalcidoidea) of the world. *Bulletin of the British Museum (Natural History) Entomology, Supplement* 23: 1–241.
- Bouček, Z. 1974b. Description of a new *Leucopsis* [sic] (Hymenoptera: Leucospidae) from Bolivia. *Studia Entomologica* 17: 430–432.
- Bouček, Z. and T. C. Narendran. 1981. The *Leucopsis* species of India and adjacent countries (Hymenoptera: Leucospidae). *Oriental Insects* 15: 1–15.
- Cameron, S. A. and S. R. Ramírez. 2001. Nest architecture and nesting ecology of the orchid bee *Eulaema meriana* (Hymenoptera: Apinae: Euglossini). *Journal of the Kansas Entomological Society* 74: 142–165.
- Chandler, L., J. A. F. Barrigossi, and E. B. S. Diaz. 1985. The first definitive host record for *Leucospis cayennensis* Westwood (Hymenoptera: Leucospidae). *Revista Ceres* 32: 170–174.
- Clausen, C. P. 1940. *Entomophagous Insects*. McGraw Hill, New York, NY. 688 pgs.
- Cooperband, M. F., R. A. Wharton, G. W. Frankie, and S. B. Vinson. 1999. New host and distribution records for *Leucospis* (Hymenoptera: Leucospidae) associated primarily with nests of *Centris* (Hymenoptera: Anthophoridae) in the dry forests of Costa Rica. *Journal of Hymenoptera Research* 8: 154–164.
- Engel, M. S. 2002. The first leucospid wasp from the fossil record (Hymenoptera: Leucospidae). *Journal of Natural History* 36: 435–441.
- Fabre, J. H. 1855. Observations sur les mœurs des *Cerceris*. *Annales des Sciences Naturelles (Zoologie et Biologie Animale)* 4: 129–150.
- Fritz, M. A. and J. A. Genise. 1980. Nota sobre nido de barro de Sphecidae (Hymenoptera) constructores, inquilinos, parasitoides, celptoparasitos y detritivoros. *Revista de la Sociedad Entomológica Argentina* 39: 67–81.
- Graenicher, S. 1906. The habits and life-history of *Leucospis affinis* (Say), a parasite of bees. *Bulletin of the Wisconsin Natural History Society* 4: 153–159.
- Habu, A. 1962. *Fauna Japonica. Chalcididae, Leucospidae, and Podagrionidae (Insecta: Hymenoptera)*. Biogeographical Society of Japan, Tokyo, Japan. 232 pgs., + 19 plates.
- Habu, A. 1977. A new *Leucospis* species from the Ryukyus, Japan (Hymenoptera: Leucospidae). *Entomological Review of Japan* 30: 47–51.
- Hanson, P. 1995. Chapter 11.10 Leucospidae. Pages 342–344. In P. H. Hanson and I. D. Gauld (editors), *The Hymenoptera of Costa Rica*. Oxford University Press, Oxford, UK. 893 pgs.
- Malyshev, S. I. 1968. *Genesis of the Hymenoptera, and the Phases of Their Evolution*. Methuen & Co., Ltd., London. (English translation of 1966 edition, Izdatelstvo 'Nauka', Moscow-Leningrad.)
- Naumann, I. D. 1981. A new species and additional records of *Leucospis Fabricius* (Hymenoptera: Leucospidae) from Australia. *Journal of the Australian Entomological Society* 20: 223–228.
- Noyes, J. S. 2001. *Interactive Catalogue of World Chalcidoidea (2001—second edition)*. CDrom. Taxapad and The Natural History Museum, London.
- Vieira de Jesus, B. M. and C. A. Garófalo. 2000. Nesting behaviour of *Centris (Heterocentris) analis* (Fabricius) in southeastern Brazil (Hymenoptera, Apidae, Centridini). *Apidologie* 31: 503–515.